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U.S. Racial Inequality May Be as Deadly as COVID-19

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Abstract:
The Covid-19 pandemic is causing a catastrophic increase in U.S. mortality. How does the scale of this pandemic compare to another U.S. catastrophe: racial inequality? Using demographic models, I estimate how many excess white deaths would raise U.S. white mortality to the best-ever (lowest) U.S. Black level under alternative, plausible assumptions about the age patterning of excess mortality in 2020. I find that nearly 400,000 excess white deaths would be needed to equal the best mortality ever recorded among Blacks. For white mortality in 2020 to reach levels that Blacks experience outside of pandemics, current Covid-19 mortality levels would need to increase by a factor of more than 6. Moreover, white life expectancy in 2020 will remain higher than Black life expectancy has ever been unless more than 665,000 excess white deaths occur. Even amid Covid-19, U.S. white mortality is likely to be less than what U.S. Blacks have experienced every year. These results pose the question of whether a similar scale of social reorganization to that embraced to prevent Covid-19 deaths ought to be undertaken to prevent a similar level of mortality experienced annually by U.S. Blacks.

The Covid-19 pandemic is likely to kill people in the United States on a scale not seen in a century, since the 1918 flu. That catastrophic flu killed over 20 million people worldwide and over half a million in the United States.*(1)* Yet mortality levels that, for white Americans, were unprecedented nevertheless were lower than mortality for U.S. Blacks in any given (non-pandemic) year. Past research has shown that the infectious mortality experienced by urban whites in 1918 was lower than the infectious mortality of urban nonwhites in every documented year through 1920.*(2)* Figure 1 shows that a similar pattern pertains to whites' and Blacks' age-adjusted total mortality and life expectancy. Whites' life expectancy in 1918 was far lower than

in other twentieth century years—yet higher than Black life expectancy in all years but one between 1900 and 1918. Similarly, whites' age-adjusted mortality in 1918 was lower than Black mortality in all years but one from 1900 to 1931. By all major mortality measures—infectious mortality, total mortality, and life expectancy—in the early decades of the twentieth century, Blacks in the United States experienced a scale of death comparable to whites' experience of the 1918 flu *every year*.

A century later, stark inequalities in survival persist. Will graphs of the early twenty-first century look like graphs of the early twentieth century, with a deadly pandemic causing a spike in mortality for whites that nevertheless remains lower than the mortality Blacks experience routinely, outside of any pandemic? This question cannot be answered definitively until the final toll of Covid-19 is known. As a framework for answering it, I estimate how many white deaths to Covid-19 would be required for white mortality in 2020 to reach the levels of Black mortality in its best recorded year.

The results provide a new context for understanding the scale of racial inequality in mortality in the United States. That racial inequality is extreme. As Figure 1 underscores, best-ever Black age-adjusted mortality and life expectancy are equivalent to white rates from, respectively, nearly 20 or 30 years earlier. For Covid-19 to raise mortality as much as racial inequality does, it would need to erase two to three decades of mortality progress for whites.

Results

I used official U.S. life tables*(3)* and demographic models to estimate how many additional deaths due to Covid-19 would be required for age-adjusted, non-Hispanic white mortality in 2020 to rise to the minimum recorded age-adjusted, non-Hispanic Black mortality, and similarly,

how many additional deaths would be required for non-Hispanic white mortality to fall to the highest recorded Black life expectancy. Mortality comparisons between Blacks and whites require age standardization*(4)* because whites are older than Blacks (median age 43 vs. 34). The estimates also require an assumed age pattern of the excess deaths, which presumably reflect both Covid-19 directly and other pathways associated with, for example, hospital avoidance.*(5)* I make two alternative assumptions: first, that white excess mortality is proportional over age to white all-cause mortality, and second, that white excess mortality throughout 2020 matches empirical estimates of the age patterning of Covid-19 mortality.*(6)*

These alternative methods produce a range of estimates of hypothetical white deaths, summarized in Table 1. In all cases, I estimate how many deaths in 2020 would raise white mortality, or lower white lifespan, to the year of the best recorded Black rates. Fig. 2 illustrates the gap between the best mortality year for Black Americans, 2014, and the most recent year with data for white Americans, 2017, which the models translated into hypothetical death counts for the white 2020 population. For hypothetical white age-adjusted mortality to equal the lowest Black age-adjusted mortality, about 390,000-399,000 excess white deaths are needed. For white life expectancy in 2020 to fall to the level of the best-recorded Black life expectancy would require an estimated 665,000 to 1 million excess white deaths.

The low-end estimate of about 390,000 deaths reflects a white excess death rate of 197 per 100,000 in the full United States, which implies an 18% increase in total white mortality from pre-pandemic levels. For comparison, 197 per 100,000 is about 89% of the aggregate official Covid-19 death rate to date in New York City (221 per 100,000), implying that the full U.S. white population would need to experience a level of excess mortality comparable to the scale of Covid-19 mortality (for all racial groups) in New York.*(7)*

Discussion

These estimates make it plausible that even in the Covid-19 pandemic, white mortality will remain lower than the lowest recorded Black mortality in the United States. If fewer than 390,000 excess white deaths occur in 2020, the Covid-19 pandemic for whites will be less consequential to overall white mortality than racial inequality is for Black mortality every year. And unless 2020 sees 665,000-1 million excess white deaths—a 31-47% increase from recent years—life expectancy for whites even amid Covid-19 will remain higher than it has ever been for Blacks. These estimates therefore provide context for understanding the scale of racial inequality in mortality in the United States.

In reality, Covid-19 deaths themselves are highly disproportionately experienced by Black Americans.*(8)* The current official death toll to Covid-19 for white Americans is 60,862.*(6)* Reaching the low-end estimate of 390,228 deaths would require a 6.4-fold increase in Covid-19 deaths. At the current distribution of Covid-19 deaths by race, this would imply 735,683 Covid-19 deaths in the United States as a whole and 169,435 Covid-19 deaths for Blacks, representing a Black Covid-19 death rate of 385 per 100,000. For comparison, this implies a Covid-19 death rate among Blacks in the U.S. that is 74% higher than the official Covid-19 death rate for New York City to date.*(7)* At the other extreme, reaching the high-end estimate of 1,019,448 excess white deaths would represent a nearly 17-fold increase in current Covid-19 deaths.

These estimates pose a deeper question. Although specific policies are highly contested, there is a relatively high level of social consensus that we should radically reorganize how we live—in the workplace, schooling, family life, travel, and so on—to minimize the risks associated with Covid-19, with lifesaving effects.*(9-11)* Yet calls to radically reorganize social institutions in order to minimize racial disparities*(12-16)* remain highly contentious.*(17-18)* The mortality

results pose a challenge: whatever scale of disruption and reorganization seems appropriate to prevent deaths to Covid-19, ought we to entertain the same scale of disruption and reorganization to prevent a likely greater scale of deaths occurring every year?

Materials and Methods

Data on historical Black and white deaths come from the National Center for Health Statistics *(3,19)*. Population denominators are from the American Community Survey via IPUMS-USA *(20)* and the Census Bureau *(21)*. Race-specific, age-specific Covid-19 mortality is from the Centers for Disease Control *(6)*. New York City data come from its Department of Health *(7)*. Equations for equalizing age-adjusted mortality and life expectancy were developed by the author. Equations, software code, and other detailed methods are available at https://osf.io/bzkcw/. Detailed methods are also included below, following the Figures.

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Models				Results	
Mortality measure	**Black 2014 (best) value**	**White 2017 (most recent) value**	**Assumption about age distribution of white excess mortality**	**Estimated white Covid-19-associated deaths for white 2020 mortality to equal minimum Black mortality**	**Hypothetical white excess mortality as a percentage of 2017 mortality**
Directly age-standardized mortality	1061 deaths per 100,000 people	899 deaths per 100,000 people	White excess mortality proportional to white all-cause mortality	390,228	18.0%
			Age distribution interpolated and extrapolated from CDC race-specific estimates	398,997	18.4%
Life expectancy	75.3 years of lifespan	78.5 years of lifespan	White excess mortality proportional to white all-cause mortality	665,291	30.7%
			Age distribution interpolated and extrapolated from CDC race-specific estimates	1,019,448	47.0%

Table 1. Models of excess white deaths to equal best-ever Black mortality and life expectancy.

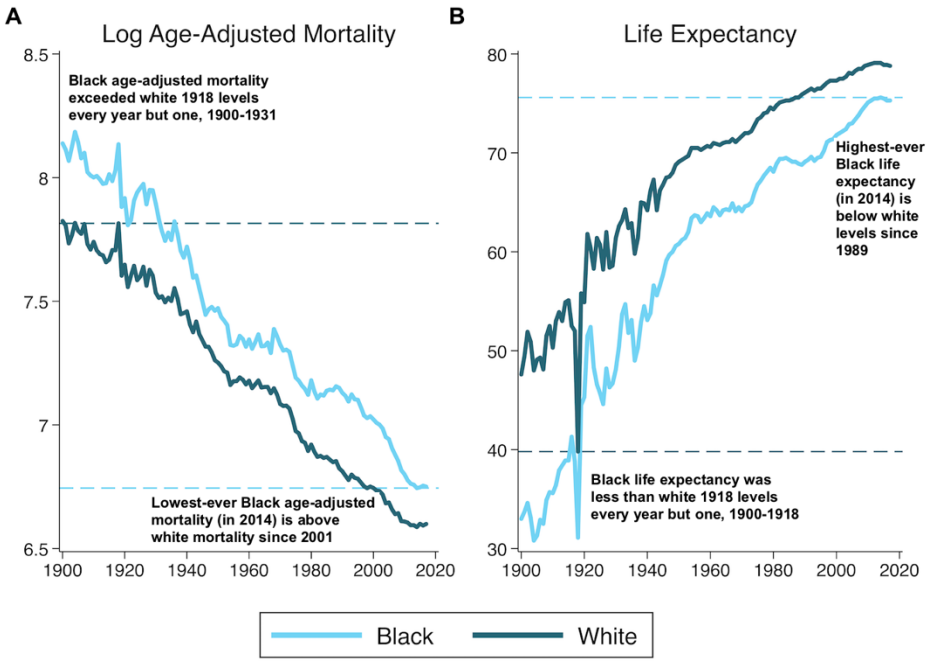

Fig 1. U.S. Black and white mortality and life expectancy, 1900-2017. (a) Logged age-adjusted mortality. Units are logged deaths per 100,000. (b) Life expectancy. Units are years of lifespan.

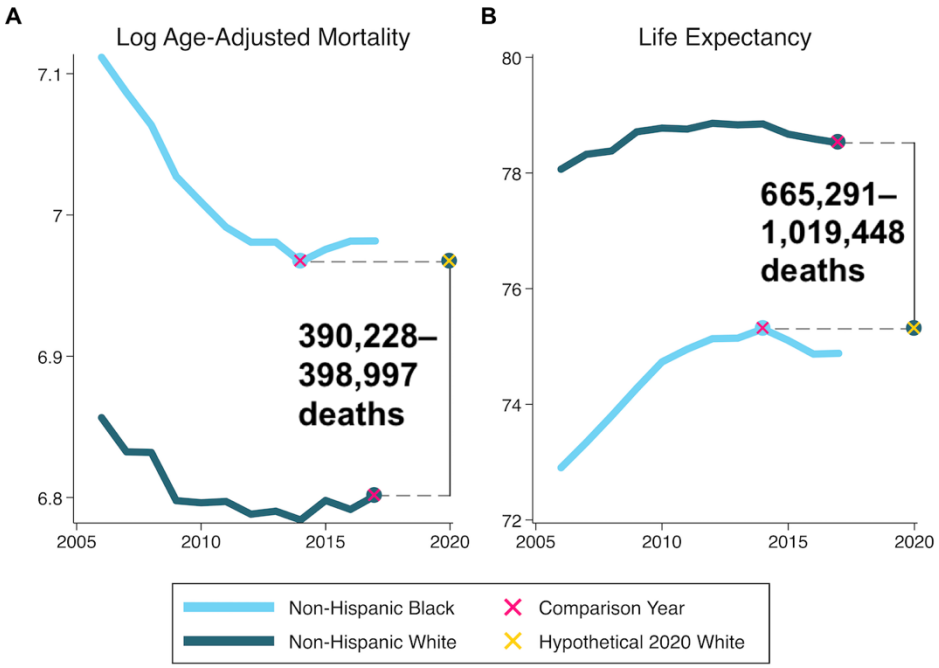

Fig. 2. Hypothetical excess white mortality that would raise white mortality, or lower white life expectancy, to best-ever Black levels. (a) Logged age-adjusted mortality. Units are logged deaths per 100,000. (b) Life expectancy. Units are years of lifespan. Non-Hispanic Black and white rates are shown from 2006-2017, representing all years with U.S. life tables for these populations. The bolded numbers represent the number of excess white deaths in 2020 needed to raise the most recent documented white mortality to the lowest-ever Black mortality, or lower the most recent documented white life expectancy to the highest-ever Black life expectancy, respectively.

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Data Availability Statement
The datasets used in this analysis are publicly available as referenced in the Materials and Methods section. The software code used is freely available at https://osf.io/bzkcw/

Materials and Methods (Detailed Version)

Death rates for non-Hispanic whites and Blacks are calculated for each year from 2006-2017, reflecting all years in which official U.S. life tables are available for these populations. Aggregate (crude) death rates (CDR) are calculated from the age-specific mortality rates derived from official life tables*(3)* and population denominators from the American Community Survey (ACS).*(20)* Ages are top-coded at 94 to ensure stable population estimates. For years with multiple official life tables reflecting alternative assumptions (about intercensal population estimates or racial classifications), all life tables are used.

The main analytical choices are motivated by the need to adjust for the different age composition of Black and white non-Hispanic U.S. populations. The respective age distributions of these populations are shown in Fig. S1. Blacks are overrepresented at young ages, and whites at older ages. Because of these differences in age composition, unadjusted aggregate death rates are higher for whites than for Blacks, even though, at specific ages, Black mortality is higher until age 85 (the so-called "black-white mortality crossover," *(22)*), as shown in Fig. S2.

All results from the main analysis and additional analyses described here are summarized in Table S1.

Direct age standardization

The main age adjustment strategy is direct age standardization, which re-weights each population's age-specific mortality using a standard, shared set of weights.*(4:pp.24-25)* The weights used here reflect the age distribution of the total U.S. population in 2018 (the most recent available year) derived from the one-year ACS,*(20)* smoothed using a loess smoother with a tri-cube weighting function and bandwidth of 0.15.

To equalize the hypothetical white 2020 standardized death rate (SDR) to the Black 2014 SDR, and then translate this hypothetical white SDR to the number of "excess" deaths beyond white 2017 levels, an age pattern of excess mortality must be assumed. The analysis makes two alternative assumptions about this age pattern.

The first assumption is that excess 2020 deaths (deaths directly or indirectly associated with Covid-19) occur in proportion to all-cause mortality, so that the white death rate at each age is raised by a constant proportion, $c^{\mathrm{h}}_{\mathrm{prop,SDR}}$. (Throughout the equations, all terms referring to hypothetical 2020 outcomes built around the assumption that age-adjusted white death rates rise to minimum Black levels—rather than empirically estimated terms—are denoted with a superscripted *h*.) This assumption yields a simple formula for relating hypothetical white 2020 age-specific mortality rates to white 2017 and Black 2014 mortality rates:

$$\begin{aligned} SDR(b,2014) &= SDR^{h}(w,2020) \\ &= \sum_{a} m^{h}(a,w,2020) f_{\mathrm{st}}(a) \\ &= c^{h}_{prop,SDR} \sum_{a} m(a,w,2017) f_{\mathrm{st}}(a) \\ &= c^{h}_{prop,SDR} SDR(w,2017) \end{aligned} \tag{1}$$

where $SDR(r,y)$ is the standardized death rate for racial group *r* in year *y*, $m(a,r,y)$ is the mortality rate at age *a* for racial group *r* in year *y*, and $f_{\mathrm{st}}(a)$ is the proportion of the standard population structure that is age *a*. Eq. 1 can be rearranged to

$$c^{h}_{prop} = \frac{SDR(b,2014)}{SDR(w,2017)}. \tag{2}$$

This proportional change is estimated to be $c^{h}_{prop} = 1.1800391$, indicating that white 2020 age-

adjusted mortality would need to rise 18 percent from white 2017 age-adjusted mortality to reach minimum Black levels. Since by assumption, c^h_{prop} applies in constant proportion to each age group, whites' unstandardized CDR would rise by the same amount, to 1290.09 per 100,000. Excess deaths are derived by applying this rate to the estimated size of the white population: 198,256,672 by the most recent, July 1, 2019 estimate.*(21)*

The second, alternative assumption is that Covid-19-associated deaths adhere to the age pattern of Covid-19 mortality among U.S. whites, as estimated from CDC data.*(6)* (Details on this estimation are given below.) That empirical age pattern, denoted $m_{\text{covid}}(a,w,2020)$, can be scaled up and down by a constant factor $c^h_{\text{covid,SDR}}$ to relate hypothetical white 2020 mortality to white 2017 and Black 2014 mortality:

$$\begin{aligned} SDR(b,2014) &= SDR^h(w,2020) \\ &= \sum_a f_{st}(a)\left[m(a,w,2017)+m^h_{2020excess}(a)\right] \\ &= SDR(w,2017)+\sum_a f_{st}(a)m^h_{2020excess}(a) \\ &= SDR(w,2017)+c^h_{\text{covid,SDR}}\sum_a f_{st}(a)m_{\text{covid}}(a,w,2020) \end{aligned} \quad (3)$$

Eq. 3 can be rearranged to:

$$c^h_{\text{covid,SDR}} = \frac{SDR(b,2014)-SDR(w,2017)}{\sum_a f_{st}(a)m_{\text{covid}}(a,w,2020)}, \quad (4)$$

which yields an estimate of $c^h_{\text{covid,SDR}} = 6.1169817$, which represents the factor by which white Covid-19 mortality would need to increase from its current levels. To translate this to an estimate of hypothetical excess deaths, the estimated hypothetical age-specific Covid-19 white mortality

is multiplied by the estimated white population at each age.

Indirect Age Standardization

As a supplement to the main analysis, I additionally used an alternative standardization method, indirect age standardization.*(4:pp.26-28)* Results using this method are shown in Table S1 and Fig. S3. Indirect age standardization compares the mortality in each racial group to mortality predicted from its age distribution, based on a standard schedule of mortality at each age. The standard mortality schedule was the population-weighted aggregate mortality for all non-Hispanic Blacks and whites, pooling across years. In years with two different life table mortality estimates, I used both estimates, each weighted by one half, to construct the aggregate standard.

To estimate the additional white deaths needed to raise the 2017 white Comparative Mortality Ratio (CMR) to the 2014 Black CMR, I use the equation:

$$\begin{aligned} CMR^{h}(w,2020) &= CMR(b,2014) \\ \frac{CDR^{h}(w,2020)}{CDR^{h}_{\exp}(w,2020)} &= \frac{CDR(b,2014)}{CDR_{\exp}(b,2014)} \\ CDR^{h}(w,2020) &= \frac{CDR_{\exp}(w,2017)}{CDR_{\exp}(b,2017)} CDR(b,2017) \end{aligned} \tag{5}$$

where $CDR_{\exp}(r,y)$ is the CDR expected for racial group *r* in year *y* based on its age distribution. The last step in Eq. 6 assumes that the age distribution of the white population does not change appreciably from 2017 to 2020, hence $CDR^{h}_{\exp}(w,2020) = CDR_{\exp}(w,2017)$. Because indirect standardization weights all deaths equally, it requires no assumption about the age pattern of hypothetical excess mortality.

Life Expectancy

Life expectancy, for each racial group *r* and year *y*, is the average lifespan of a synthetic cohort that successively experienced racial group *r*'s age-specific mortality rates in *y.(4:pp.51-53)*

Hypothetical white life expectancy in the presence of Covid-19 mortality is estimated from new life tables in which white 2020 mortality is raised from white 2017 mortality using two alternative assumptions that parallel the alternative assumptions in the direct age standardization. First, assuming that Covid-19 raises white mortality in constant proportion over age, hypothetical white mortality is given by

$$m^h(a,w,2020) = c^h_{\text{prop},e(0)} \cdot m(a,w,2017). \tag{6}$$

Alternatively, assuming that Covid-19 raises white mortality in proportion to the age pattern estimated from CDC data (described below), hypothetical white mortality is given by

$$m^h(a,w,2020) = m(a,w,2017) + c^h_{\text{covid},e(0)} \cdot m_{\text{covid}}(a,w,2020). \tag{7}$$

The values of the two constants $c^h_{prop,e(0)}$ and $c^h_{\text{covid},e(0)}$ are estimated using a trial-and-error algorithm to find the values that result in the equality $e^h(0,w,2020) = e(0,b,2014)$, for life expectancy $e(0)$, to six decimal places. To translate these two alternative estimates of sets of $m^h(a,w,2020)$ values into a death count, each is multiplied by the estimated white age-specific population. The values estimated from Covid-19 mortality data for the respective life expectancy models are $c^h_{prop,e(0)} = 1.3069449$, indicating a 31% increase in all-cause mortality, and $c^h_{\text{covid},e(0)} = 15.629049$, indicating excess mortality equal to a nearly 16-fold increase in Covid-19 mortality rates.

In constructing the new life tables, to estimate the life table "$_{n}a_{x}$ values" (the mean portion of each year lived by those who die during the year), I recovered the values from the official U.S. life tables. Extending those estimates into the 2020 hypothetical simplifies reality since, as mortality rises due to Covid-19, the portion of the interval lived by those who die during it will typically be expected to shrink. However, retaining the original estimates of the per-death person-years in each interval is standard when age intervals are a single year, since in that case they make very little difference.*(4:pp.81-84)*

Age Pattern of Covid-19 Mortality for White Americans

CDC data give estimated Covid-19 mortality rates by race, ethnicity, and age.*(6)* The data used are the July 8, 2020 (most recent) data release, reflecting deaths through July 3, 2020. The rates used are for non-Hispanic whites. The rates themselves amount to a scaling factor in the main analysis, and are not directly important to the final estimation of deaths; the shape of the rates over age, however, is important. Reporting errors in the official Covid-19 data matter to this analysis to the extent that they do not affect estimated Covid-19 counts equally at all ages.

The CDC data are reported in 10-year age intervals. For the analyses in the main text, these were interpolated and extrapolated on log scale to single-year estimates, attributing the CDC rate to the mean age of the white population within each age interval. The CDC rates and extrapolated rates are shown in Fig. S4. The age pattern of white Covid-19 mortality in 2020, compared to white all-cause mortality in 2017, is shown in Fig. S5.

As an alternative strategy and a sensitivity analysis, the analyses using the empirical age distribution of Covid deaths were repeated using the 10-year age units reported by the CDC, without interpolation and extrapolation. The results are reported in Table S1. Results obtained

using this alternative approach are extremely similar to those estimated using the main models.

Additional Analyses

Fig. 1, which places the main analyses into historical context, uses mortality and life expectancy estimates generated by the NCHS for 1900-2017.*(19)* The estimates shown in Fig. 1 differ from those in the main analyses in the article in two respects. Most importantly, while the main analysis considers non-Hispanics whites and Blacks, the NCHS data represent all whites and all Blacks, including Hispanics, due to inconsistency in data collection on Hispanic identity during most of the twentieth century. Of secondary importance, the age-adjusted mortality shown in Fig. 1 is a direct age standardization based on the 2000 U.S. population as an age standard, while the age standard used in the main analysis is based on 2006-2017 age distributions.

The estimation of how many Black and total deaths correspond to the low-end estimate of hypothetical white Covid deaths is based on CDC estimates for Black and total Covid mortality.*(6)* Current CDC race-specific estimates (updated July 8, 2020) give 60,862 non-Hispanic white, 26,426 non-Hispanic Black, and 114,741 total Covid-19 deaths. The contextual information comparing those rates to Black Covid-19 death rates in New York City draws on data from the New York City Department of Health, which puts the New York City Covid-19 death rate at 221.68 per 100,000 as of July 8, 2020.*(7)* To create the final column of Table 1, I estimate baseline mortality from the 2017 mortality estimates and the July 1, 2019 populations so that the baseline mortality and 2020 hypothetical excess mortality are estimated using the same population size.

Additional Reference to Detailed Methods

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Models					Results	
Mortality measure	**Black 2014 (best) value**	**White 2017 (most recent) value**	**Assumption about age distribution of white excess mortality**	**Age Units**	**Estimated white Covid-19-associated deaths for white 2020 mortality to equal minimum Black mortality**	**Hypothetical white excess mortality as a percentage of 2017 mortality**
Age-adjusted (directly age-standardized) mortality	1061 deaths per 100,000 people	899 deaths per 100,000 people	White excess mortality proportional to white all-cause mortality	Single year	390,228	18.0%
			Age distribution estimated from CDC race-specific estimates	Single year (extrapolated)	398,997	18.4%
				10 years (directly estimated)	407,445	18.8%
Indirectly age-standardized mortality	118 percent of "expected" death rate (based on age structure)	97 percent of "expected" death rate (based on age structure)	None	Single year	471,947	21.8%
Life expectancy	75.3 years of lifespan	78.5 years of lifespan	White excess mortality proportional to white all-cause mortality	Single year	665,291	30.7%
			Age distribution estimated from CDC race-specific estimates	Single year (extrapolated)	1,019,448	47.0%
				10 years (directly estimated)	1,000,128	46.1%

Table S1. Models of excess white deaths that would raise white mortality, or lower white life expectancy, to best-ever Black levels. This table adds three models to those included in Table 1: indirectly age-standardized mortality; and, for age-adjusted (directly age-standardized) mortality and life expectancy, values using empirical estimates of the age pattern of white Covid-19 mortality from the CDC in their original 10-year age units.*(6)*

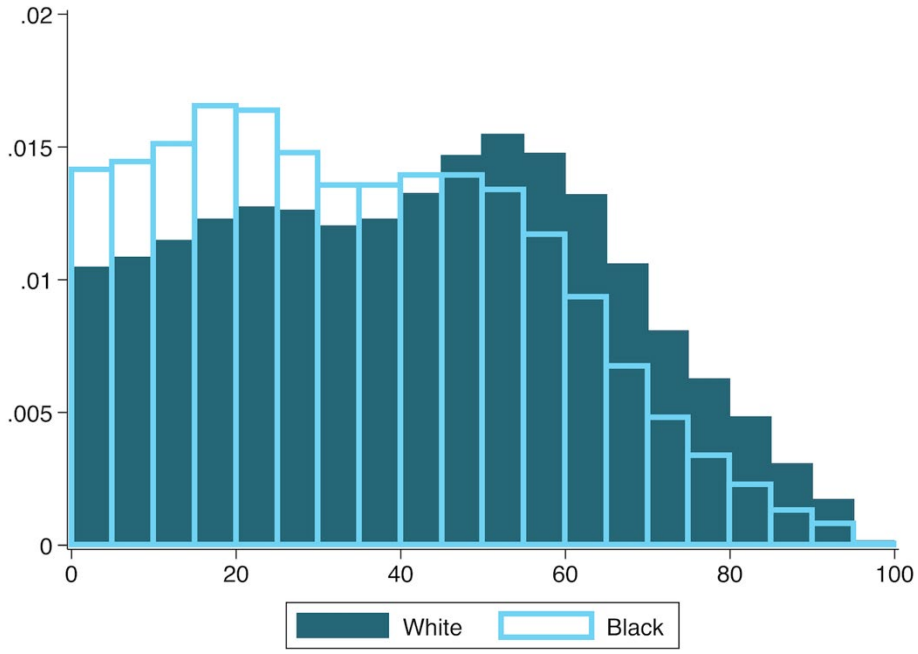

Fig. S1. Non-Hispanic Black and white age distributions in 2017. Units are densities. Data are from the 2017 single-year American Community Survey via IPUMS-USA.*(19)*

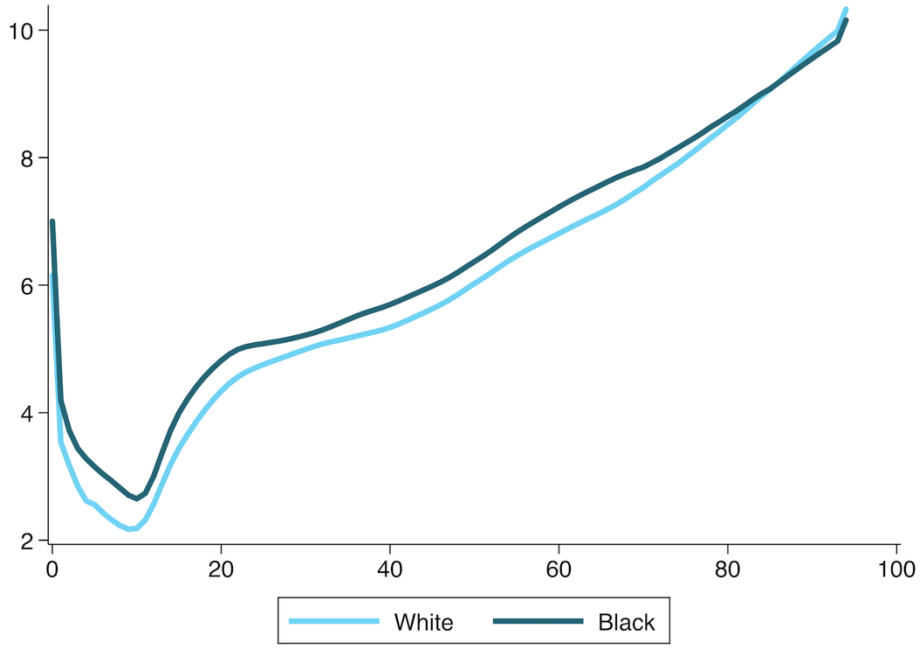

Fig. S2. Non-Hispanic Black and white age-specific mortality in 2017. Units are logged deaths per 100,000. Estimates are derived from data provided by the National Center for Health Statistics.*(3)*

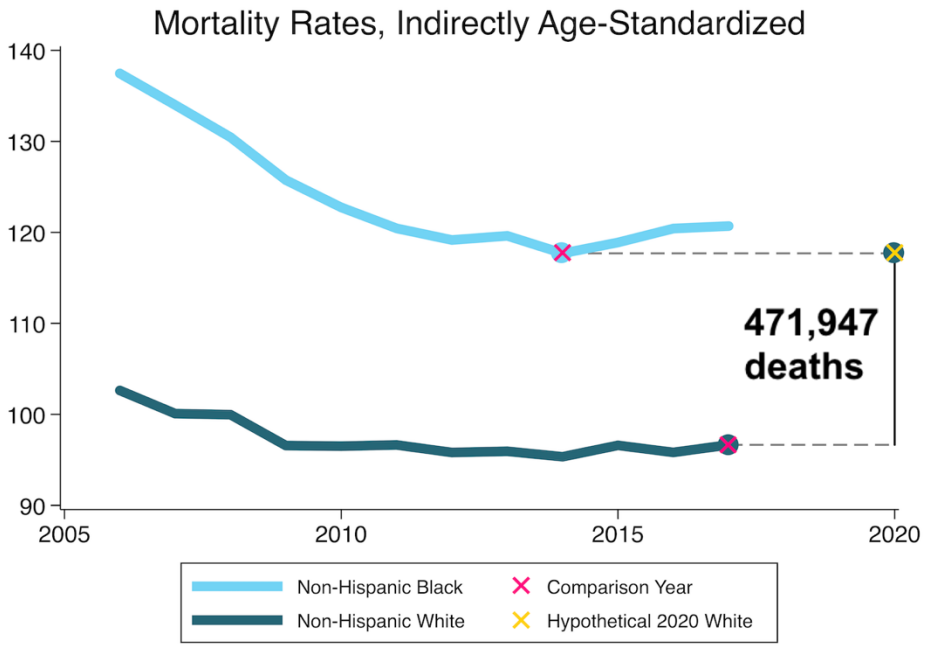

Fig. S3. Indirect age standardization model of hypothetical excess white mortality to reach best-ever Black levels. Units are the percent of "expected" death rates based on the population's age distribution and a standard mortality schedule. Non-Hispanic Black and white rates are shown from 2006-2017, representing all years with U.S. life tables for these populations. The bolded numbers represent the number of excess white deaths in 2020 needed to raise most recent (2017) documented white mortality to lowest-ever (2014) Black mortality, using indirect age adjustment.

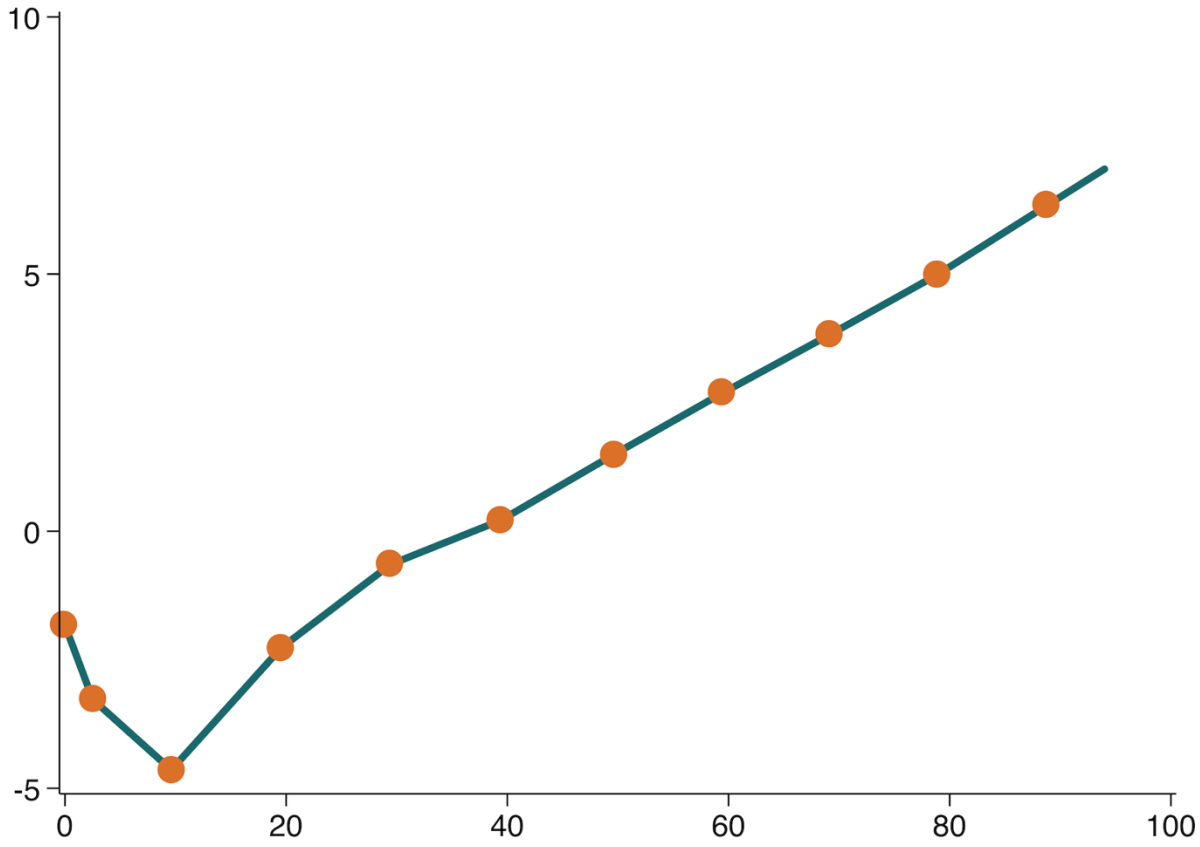

Fig. S4. Covid-19 mortality for U.S. non-Hispanic whites. Units are logged deaths per 100,000. Points represent data reported by the CDC*(6)* for 10-year age intervals, attributed to the mean age of the interval for non-Hispanic whites. The line represents interpolated and extrapolated values used in the main analysis. The original CDC data is used in the additional analyses reported in Table S1.

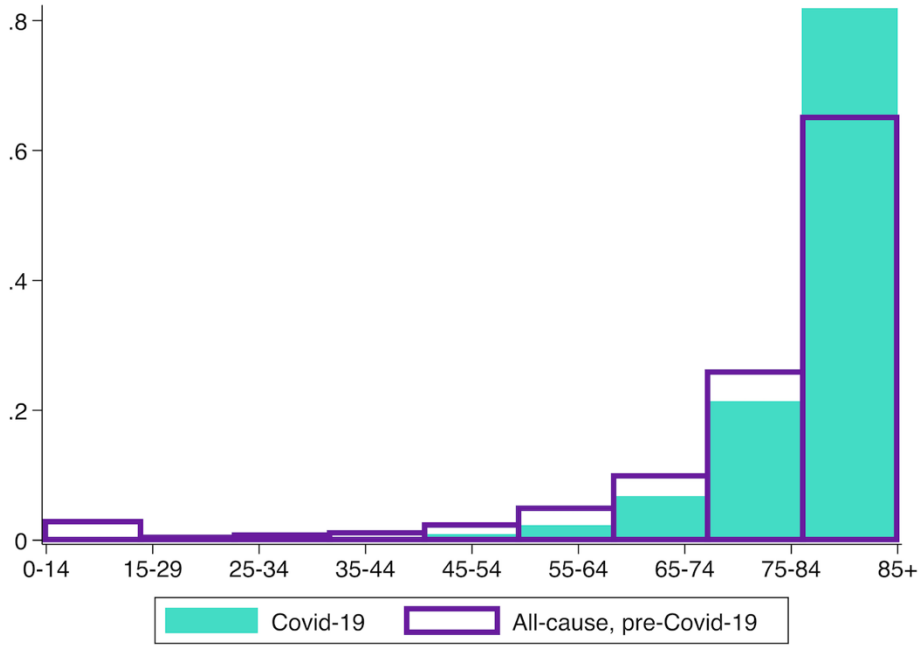

Fig. S5. Age pattern of Covid-19 mortality and all-cause mortality for U.S. non-Hispanic whites. Bars represent the density of deaths for each age group. Covid-19 data are from the CDC.*(6)* All-cause mortality is from 2017.*(3)*